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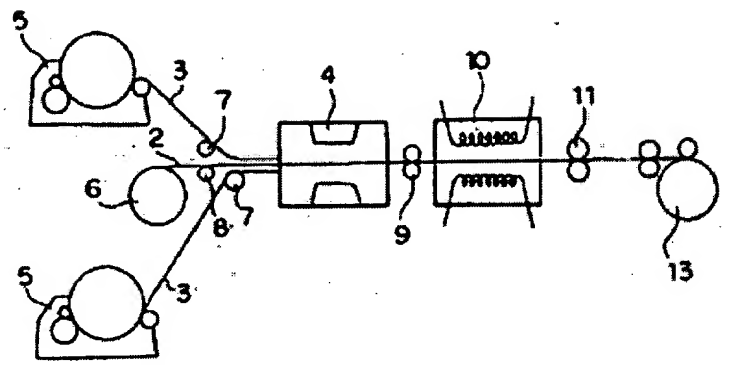
(21) Application No.: 7-228342	(71) Applicant: 000000918 Kao Corp.
(62) A division of Paent Application No. 5-333310	(72) Inventor: Akihito Shizuno
(22) Filing Date: Dec. 27, 1993	(72) Inventor: Hiroyuki Yanagida
	(74) Agent: Osamu Hattori, Patent Attorney

(54) [Title of the Invention] **Production of Cleaning Sheet**

(57) [Abstract]

[Object] To provide a method for producing a cleaning sheet which has the strength needed for cleaning as well as the degree of fiber freedom needed to trap dust.

[Structure] The invention is characterized in that fiber webs with a basis of weight ranging from 40 to 100 g/m^2 are laminated to both sides of a reticulated sheet, they are then subjected to a water needling treatment under low energy conditions, and the fiber web laminated to one side of the reticulated sheet is interlaced together with the fiber web on the other side, with the gap provided by the reticulated sheet still between them.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[Claims]

[Claim 1] A method for producing a cleaning sheet, characterized in that fiber webs with a basis of weight ranging from 40 to 100 g/m^2 are laminated to both sides of a reticulated sheet, they are then subjected to a water needling treatment under low energy conditions, and the fiber web laminated to one side of the reticulated sheet is interlaced together with the fiber web on the other side, with the gap provided by the reticulated sheet still between them.

[Claim 2] A method for producing a cleaning sheet according to Claim 1, wherein the interlacing coefficient, as represented by the initial slope of a stress-strain curve perpendicular to the fiber orientation, in the fiber aggregate in the form of a nonwoven fabric in the cleaning sheet is 10 to 500 m.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application]

The present invention relates to the production of a business or household cleaning sheet using a nonwoven fabric, and in particular to the production of a dry cleaning sheet for trapping various types of dust.

[0002]

[Prior Art and Problems Which the Invention Is Intended to Solve]

Conventional dry cleaning cloths are commonly woven or nonwoven fabrics impregnated with an oily substance. Dirt on surfaces that are to be cleaned is adsorbed away through the wetness of the oily substance. The fibers in cleaning sheets of nonwoven fabrics are joined more tightly together by adhesion, fusion, or stronger interlacing, so as to avoid leaving scraps or broken fibers behind after cleaning. Although the oily substance in such cleaning sheets does adsorb extremely small types of dirt such as dust, it is not very satisfactory for trapping larger types of dirt such as cotton dust, lint, and hair.

[0003]

Fibers with a high degree of freedom must be interlaced in order to trap larger types of dirt such as cotton dust, line, and hair. In nonwoven fabrics formed with interlaced fibers, the constituent fibers generally have a greater degree of freedom than in nonwoven fibers produced solely by adhesion or fusion of the fibers, and the entanglement between dust and such fibers

results in a better dust-trapping capacity. Nonwoven fabrics with looser fiber interlacing have a better dust-trapping capacity, although interlacing that is too loose results in a nonwoven fabric with a dramatic loss of strength and poor processability, with a tendency for fibers to fall off.

[0004]

An object of the present invention is thus to provide a method for producing a cleaning sheet which has the strength needed for cleaning as well as the degree of fiber freedom needed to trap dust.

[0005]

[Means for Solving the Abovementioned Problems]

As a result of extensive research to achieve the above objects, the inventors discovered that a sheet obtained by laminating fiber webs to a reticulated sheet and interlacing the materials together by water needling or the like could be used as a cleaning sheet. The present invention, which is based on the above findings, is intended to provide a method for producing a cleaning sheet, characterized in that fiber webs with a basis of weight ranging from 40 to 100 g/m^2 are laminated to both sides of a reticulated sheet, they are then subjected to a water needling treatment under low energy conditions, and the fiber web laminated to one side of the reticulated sheet is interlaced together with the fiber web on the other side, with the gap provided by the reticulated sheet still between them.

[0006]

The breaking strength is the load (first peak during measurement of tensile strength) as the cleaning sheet starts to tear when a tensile load is placed on the sheet, and the elongation is the percentage the sheet stretches when the load is 500 g/300 mm. The interlacing coefficient is an index of the state of the interlacing between the constituent fibers, and is represented by the initial slope of a stress-strain curve perpendicular to the fiber orientation in the fiber aggregate in the form of a nonwoven fabric in the cleaning sheet. The lower the value, the looser the interlacing between fibers. The stress indicates the tension load divided by the clamp with (sample width during measuring of tensile strength) and the basis weight of the nonwoven fabric fiber aggregate, while the strain indicates the elongation.

[0007]

The cleaning sheet of the invention is illustrated below with reference to the attached figures. Figure 1 is a cross section of an embodiment (example) of the cleaning sheet of the invention. Figure 2 is a cross section of another embodiment (example) of the cleaning sheet. Figures 3 and 4A, 4B, and 4C are plans of a reticulated sheet which can be used in the cleaning sheet of the invention.

[0008]

The cleaning sheet of the invention comprises a reticulated sheet 2 (or 12) and fiber aggregates 3. As shown in Figures 1 and 2, on one or both sides of the reticulated sheet 2 (or 12), nonwoven fabric fiber aggregates 3 formed by the interlacing of the fiber webs are united by the interlacing between the constituent fibers as well as the interlacing relative to the reticulated sheet 2 (or 12). The reticulated sheet 2 is not limited to the latticed net illustrated in Figure 3. Porous films 12 with numerous pores, as illustrated in Figures 4A through 4C, may also be used. The reticulated sheet is not limited, provided that it has constant pores and can serve as a carrier by which the fiber webs forming the fiber aggregates 3 can be united in an interlaced state. Examples of reticulated sheets which can be used in the cleaning sheet of the invention include coarse woven fabrics with relatively large weaving spaces such as gauze, or nonwoven fabrics with gaps between the fibers allowing fiber webs o be placed on one or both sides and united in an interlaced state. The shapes of the pores formed in the reticulated sheets 2 and 12 in Figures 3 and 4 can be in various shapes. In the porous film 12 or the like, they may be circular, as in Figure 4A, star-shaped, as in Figure 4B, or a combination thereof, as in Figure 4C.

[0009]

The material of the reticulated sheet 2 or 12 can be suitably selected from polyolefins such as polyethylene, polypropylene, and polybutene, polyesters such as polyethylene terephthalate and polybutylene terephthalate, polyamides such as nylon 6 and nylon 66, as well as acrylonitrile, and vinyl or vinylidene, such as polyvinyl chloride and polyvinylidene chloride, or variants, alloys, and mixtures of the above.

[0010]

When the reticulated sheet 2 of Figure 3 is used, the mesh, line diameter, distance between lines, ore diameter, pore pitch, pore pattern, and the like must be determined upon a consideration of the partial interlaceability with the nonwoven fabric fiber aggregates.

Specifically, the line diameter should be 20 to 500 μm, and preferably 100 to 200 μm. The distance between lines should be 2 to 30 mm, and preferably 4 to 20 mm. When a reticulated sheet 12 in the form of the porous film in Figure 4 is used, the pore diameter should be 4 to 40 mm, and preferably 8 to 20 mm. The gap between pores should be 1 mm to 10 mm, and preferably 1 to 5 mm. When reticulated sheets other than the above are used, such as the previously described woven and nonwoven fabrics, the pore diameter and fiber spacing, etc., should be determined upon a consideration of the partial interlaceability with the nonwoven fabric fiber aggregates.

[0011]

Examples of fibers used in the fiber aggregates 3 include thermoplastic fibers such as polyesters, polyamides, and polyolefins, conjugated fibers thereof, splitting fibers or melt blown ultrafine fibers, semi-synthetic fibers such as acetate, regenerated fibers such as rayon and cupra, and natural fibers such as cotton.

[0012]

The nonwoven fabric fiber aggregates should have a basis weight of 40 to 100 g/m^2. Less than 40 g/m^2 will result in a tendency for dust to come out on the other side when used as a cleaning sheet, so that the hands or the like become dirty. More than 100 g/m^2 will not allow the fibers and reticulated sheet to be sufficiently interlaced at the desired interlacing coefficient, resulting in a cleaning sheet with poor processability and a tendency for fibers to fall off. The denier, fiber length, cross section, strength, and the like of the fibers used in the nonwoven fabric fiber aggregates should be determined upon a comprehensive consideration of processability and costs, etc. Surfactants or oils for improving the surface properties of the nonwoven fabric fiber aggregates to improve dust pick up or oils for improving the luster of the cleaned surface and the like may also be added as befits the intended function of the sheet.

[0013]

It is important for the cleaning sheet of the invention comprising the reticulated sheet and fiber aggregates to have a breaking strength of at least 500 g/30 mm, en elongation of no more than 10% at a load of 500 g/30 mm, and an interlacing coefficient of 10 to 500 m. If the breaking strength is less than 500 g/30 mm, the cleaning sheet can tear when used. The cleaning sheet should have low elongation. At an elongation over 10% at a load of 500 g/30 mm, the sheet will

become stretched and wrinkled when used, making it inconvenient to use. These problems become particularly pronounced when the sheet is attached to a tool such as a mop.

[0014]

When the interlacing coefficient, as represented by the initial slope of a stress-strain curve perpendicular to the fiber orientation, in the fiber aggregate, is no more than 500 m, as in the cleaning sheet of the invention, it is difficult to achieve the above defined breaking strength and elongation with just the fiber aggregates. The fiber aggregates must be interlaced together with a reticulated sheet in order to achieve the desired values in the invention. Compared to an interlaced sheet in the same loosely interlaced state but consisting only of fiber aggregates, the cleaning sheet of the invention has low elongation because the fiber aggregates are interlaced together with a reticulated sheet, so that fewer fibers fall off.

[0015]

When the interlacing coefficient is less than 10 m, the fibers will not be sufficiently interlaced nor will the fibers and the reticulate sheet, resulting in a nonwoven fabric from which fibers tend to fall off. At an interlacing coefficient over 500 m, the interlacing will be too tight, resulting in an unsatisfactory degree of fiber freedom and less entanglement of dust, with a correspondingly lower dust-trapping capacity. The extent of interlacing between fibers sis determined by the interlacing energy on the fiber web during the interlacing treatment. The interlacing energy on the fiber web can be controlled in water needling, for example, based on conditions such as the type of fiber, basis weight of the fiber web, the number of water jet nozzles and the water pressure, the line speed, and the like.

[0016]

The method for producing the cleaning sheet of the invention is described below. Figure 5 illustrates manufacturing equipment for the cleaning sheet in the invention. To produce the cleaning sheet of the invention, fiber webs are first placed on one or both sides of a reticulated sheet, and the fibers of the fiber web on one side of the reticulated sheet are interlaced by running water or the like with the fibers of the fiber web on the other side, and the fibers of the fiber webs are also interlaced with the reticulated sheet. At the same time, the fiber webs are secured in the form of nonwoven fabric fiber aggregates to the reticulated sheet by means of the interlacing.

[0017]

Figure 5 is an example of manufacturing equipment for the cleaning sheet of the invention, and can be used to produce the cleaning sheet illustrated in Figure 2. As illustrated in Figure 5, a fiber web 3 is continuously fed out by feed rolls 7 from carding machines 5 and 5 for producing the fiber web 3. A supply roll 6 for the reticulated sheet 2 is disposed between the carding machines 5 and 5, allowing the reticulated sheet 2 to be fed out from the feed roll 8 of the supply roll 6.

[0018]

Fiber aggregates 3 and 3 are placed on the reticulated sheet 2 by the feed rolls 7 and 7 on either side of the reticulated sheet 2 and are guided to the water needling machine 4. As a result of the jet water flow here, the fibers of the fiber webs 3 are interlaced with the reticulated sheet 2, and the fiber webs 3 and 3 on either side of the reticulated sheet 2 are interlaced together. The interlaced fiber aggregates 3 and the reticulated sheet 2 are guided through a nip roll 9 to a heating device 10 and are heat treated to be dried and the like. The heat treated sheet is taken up through a nip roll 11 by a winder 13, thus giving the cleaning sheet of the invention.

[0019]

[Examples]

The invention is illustrated in further detail by the following examples. The following evaluating tests in 1 through 6 were conducted in the examples and comparative examples. The results are given in Table 1. It need hardly be mentioned that the invention is not limited to the following examples.

[0020] Tests

1) Breaking Strength (Transverse Strength)

30 mm wide samples were cut out in the direction perpendicular to the fiber orientation of the sheet, the samples were clamped in tension testers, with a 100 mm interval between chucks, and they were pulled at a rate of 300 mm/min in the direction perpendicular to the fiber orientation. The breaking strength was the load at which the sheets began to tear (first peak of the continuous curve obtained by these measurements).

[0021] 2) Elongation at 500 g/30 mm Load

The elongation of the samples was measured at a load of 500 g in the previous measurements of breaking strength. Elongation was also evaluated according to the 3 ranks below based on convenience of use as a result of becoming stretched or wrinkled during use.

O: no stretching or wrinkling

Δ: somewhat hard to use because of wrinkling and twisting

×: unusable because of wrinkling and twisting

[0022] 3) Interlacing Coefficient

15 mm wide samples were cut out in the direction perpendicular to the fiber orientation from the nonwoven fabric fiber aggregates of the sheets (with the reticulated sheet removed), the samples were clamped in tension testers, with a 50 mm interval between chucks, and they were pulled at a rate of 30 mm/min in the direction perpendicular to the fiber orientation. The tensile load relative to sheet elongation was measured. A stress-strain (elongation) curve was determined, where the stress S (m) was the tensile load F (g) divided by the sample width (m) and the nonwoven fabric fiber aggregate basis weight W (g/m^2).

Stress S (m) = (F/0.015)/W

[0023]

The nonwoven fabric fiber aggregates consisting of interlaced fibers have a stress-strain (elongation) curve that is initially linear. This linear slope is considered the interlacing coefficient E (m). In the stress-strain (elongation) curve in Figure 6, for example, the interlacing coefficient is represented by $E = S_P/\gamma_P$, where P is the proportional limit, S_P is the stress at P, and γ_P is the strain (elongation) at P. (E = 60/0.86 = 70 m, when S_P = 60 m and γ = 86%). However, since the OP is sometimes not strictly linear, the linearity will have to be approximated.

[0024] 4) Fiber Shedding

A mechanical friction test was conducted for evaluation by the following three ranks based on the amount of fibers that fell off.

O: virtually none

Δ: some, but usable

×: considerable, unusable

[0025] 5) Dust-Trapping Capacity

The capacity for trapping cotton dust (cotton and polyester) and hair was evaluated by the four following ranks.

*: no problems with trapping dust

O: virtually no problems with trapping dust

Δ: considerable dust left over

×: virtually none trapped

[0026] 6) Dust Penetration

0.5 g of the 7 kinds of dust in the JIS test was trapped with a sheet surface area of 60 cm^2, and the extent to which dust penetrated through to the other side was assessed according to the three following ranks.

O: virtually none

Δ: some

×: considerable

[0027] Example 1

The reticulated sheet was a polypropylene net (9 mm space between lines, 0.2 mm line diameter). 51 mm polyester fibers with a denier of 1.5 were laminated as the fiber aggregates by common carding machines onto the top and bottom of the reticulated sheet, so as to result in fiber webs with a basis weight of 48 g/m^2. The resulting object was subjected to a water needling treatment at low energy, giving a sheet with a breaking strength of 1320 g/30 mm, an elongation of 4% at a 500 g/30 mm load, and an interlacing coefficient of 70 m.

[0028] Example 2

The reticulated sheet was a polypropylene net (9 mm space between lines, 0.2 mm line diameter). 51 mm polyester fibers with a denier of 1.5 were laminated as the fiber aggregates by common carding machines onto the top and bottom of the reticulated sheet, so as to result in fiber webs with a basis weight of 48 g/m^2. The resulting object was subjected to a water needling treatment at low energy (somewhat higher than in Example 1), giving a sheet with a breaking strength of 1500 g/30 mm, an elongation of 4% at a 500 g/30 mm load, and an interlacing coefficient of 320 m.

[0029] Example 3

The reticulated sheet was a polypropylene net (9 mm space between lines, 0.2 mm line diameter). 51 mm polyester fibers with a denier of 1.5 were laminated as the fiber aggregates by common carding machines onto the top and bottom of the reticulated sheet, so as to result in fiber webs with a basis weight of 35 g/m^2. The resulting object was subjected to a water needling treatment at low energy (same as in Example 1), giving a sheet with a breaking strength of 1290 g/30 mm, an elongation of 4% at a 500 g/30 mm load, and an interlacing coefficient of 130 m.

[0030] Example 4

The reticulated sheet was a polypropylene net (9 mm space between lines, 0.2 mm line diameter). 51 mm polyester fibers with a denier of 1.5 were laminated as the fiber aggregates by common carding machines onto the top and bottom of the reticulated sheet, so as to result in fiber webs with a basis weight of 120 g/m^2. The resulting object was subjected to a water needling treatment at low energy (same as in Example 2), giving a sheet with a breaking strength of 1700 g/30 mm, an elongation of 4% at a 500 g/30 mm load, and an interlacing coefficient of 240 m.

[0031] Comparative Example 1

51 mm polyester fibers with a denier of 1.5 were carded in the usual manner into fiber webs with a basis weight of 48 g/m^2, and were subjected to a water needling treatment at low energy (same as in Example 1), giving a sheet with a breaking strength of 810 g/30 mm, an elongation of 126% at a 500 g/30 mm load, and an interlacing coefficient of 80 m.

Comparative Example 2

51 mm polyester fibers with a denier of 1.5 were carded in the usual manner into fiber webs with a basis weight of 60 g/m^2, and were subjected to a water needling treatment at medium energy, giving a sheet with a breaking strength of 2200 g/30 mm, an elongation of 26% at a 500 g/30 mm load, and an interlacing coefficient of 620 m.

[0032]

[Table 1]

		Example				Comparative Example	
		1	2	3	4	1	2
Fiber aggregate weight (g/m^2)							
Breaking strength (g/30 mm)		1320	1500	1290	1700	810	2200
Elongation	(%)	4	4	4	4	126	26
	Rating	O	O	O	O	×	Δ
Interlacing coefficient (m)		70	320	130	240	30	620

Fiber shedding		O	O	O	Δ	×	Δ
Dust trapping	Cotton	*	O	O	O	*	O
	Hair	*	O	O	O	O	Δ
Dust penetration		O	O	Δ	O	O	O

Elongation: at 500 g/30 mm load

[0033]

Table 1 shows that the interlacing would have to be tightened or that an adhesive or fusing treatment would be needed in order to ensure that the elongation was no more than 10% at a 500 g/30 mm load or to prevent fibers from being shed in Comparative Examples 1 and 2 which had not reticulated sheet. If that were to be done, however, the interlacing coefficient would be higher than it is in Comparative Example 2, resulting in an even lower dust trapping capacity. Furthermore, if the nonwoven fabric fiber aggregates of the sheets were to have a basis weight lower than 40 g/m^2, dust would penetrate through to the other side of the sheet, while a basis weight higher than g/m^2 would result in more fiber shedding.

[0034]

It may thus be seen that the combination of the nonwoven fabric fiber aggregates with a reticulated sheet and the looser interlacing in the cleaning sheet of the invention provided the strength needed for cleaning while also ensuring the capacity to trap a broader range of dust because the fibers have a greater degree of freedom which allows them to become entangled with larger types of debris such as cotton dust, line, and hair that cannot be trapped by conventional types of cleaning cloths.

[Merit of the Invention]

The cleaning sheet of the invention has the strength needed for cleaning and also has the degree of fiber freedom needed to trap dust.

[Brief Description of the Figures]

Figure 1 is a cross section of an embodiment of the cleaning sheet of the invention.

Figure 2 is a cross section of another embodiment of the cleaning sheet.

Figure 3 is a plan of a reticulated sheet which can be used in the cleaning sheet of the invention.

Figures 4A, 4B, and 4C are plans of a reticulated sheet which can be used in the cleaning sheet of the invention.

Figure 5 illustrates manufacturing equipment for the cleaning sheet in the invention.

Figure 6 illustrates a stress-strain curve.

[Legends]

1: cleaning sheet

2, 12: reticulated sheet

3: fiber aggregates

4: water needling device

5: carding machine

6: roll for providing reticulated sheet

7: fiber web feed roll

8: reticulated sheet feed roll

9, 11: nip rolls

10: heating device

13: winder

Figure 1

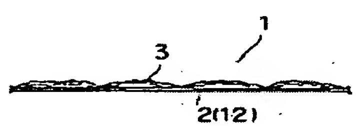

Figure 2

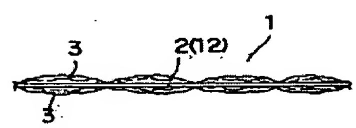

Figure 3

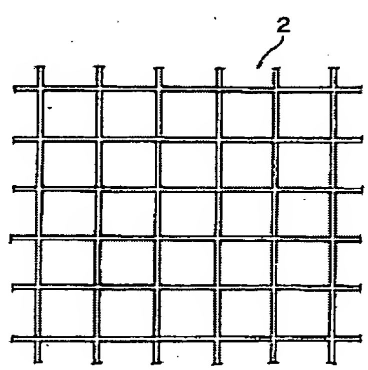

Figure 4

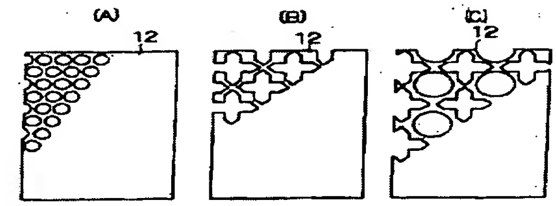

Figure 5

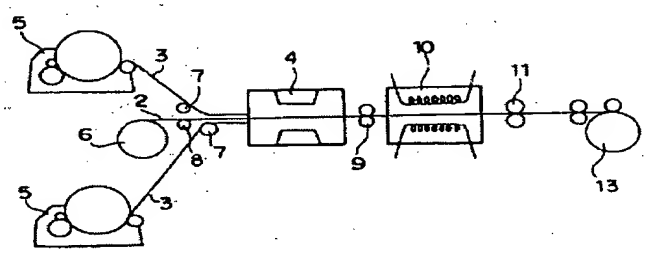

Figure 6